ARTS 4391.001 Topics in Studio Art Electronic Toolkit for Visual Arts Studio
CA 112B
Spring 2017

- Office Hours: MW 1:30-2:45 TR 3:30-4:45 I may be in a class room I teach in.
- Final Exam: Monday May 8, 1:45 - 4:15PM
- Class time MW 3:30-6:20
- Name of Instructor: Katz, Louis
- Office phone number: 361 825-5987
- E-mail address: louis.katz@tamucc.edu
- Office number and building: CA112
- This syllabus is subject to change.
- LOCKERS: See the Art Office (CA107) to reserve a locker in the hallway. You will need one. The sooner you get one the closer it will be to the studio. If you wait there might not be one available.

January 18  Classes begin
January 25  Last day to late register or add a class
February 28  Last day to apply for Spring graduation
March 10  Last Day of classes for 1st 7-Week Session and Final Exams
March 13-17  Spring Break
March 20  First Day of Classes 2nd 7-week session
March 22  Grades Due for 1st 7-Week Session
April 7  Last day to drop a class
May 1  Last day to withdraw from the University
May 2  Last day of classes
May 11-12  Final Exams 2nd 7-Week Session
May 13  Spring Commencement
May 4-5,  Reading Day
May 8-10  Final examinations
May 11-12  Grading days

Required statements:

ACADEMIC ADVISING
The College of Liberal Arts requires that students meet with an Academic Advisor as soon as they are ready to declare a major. Degree plans are prepared in the CLA Academic Advising Center. The University uses an online Degree Audit system. Any amendment must be approved by the Department Chair and the Office of the Dean. All courses and requirements specified in the final degree plan audit must be completed before a degree will be granted. The CLA Academic Advising Office is located in Driftwood #203. For more information, please call 361-825-3466.

DISABILITY SERVICES
The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please call or visit Disability Services at (361) 825-5816 in Corpus Christi Hall, Room #116.

If you are a returning veteran and are experiencing cognitive and/or physical access issues in the classroom or on campus, please contact the Disability Services office for assistance at (361) 825-5816.

GRADE APPEALS PROCESS
As stated in University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures, a student who believes that he or she has not been held to appropriate academic standards as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading, may appeal the final grade given in the course. The burden of proof is upon the student to demonstrate the appropriateness of the appeal. A student with a complaint about a grade is encouraged to first discuss the matter with the instructor. For complete details, including the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, see University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures (available at http://academicaffairs.tamucc.edu/rules_procedures/assets/13.02.99.C2.01_student_grade_appeal_procedure.pdf). For complete details on the process of submitting a formal grade appeal, please visit the College of Liberal Arts website, http://cla.tamucc.edu/about/student-resources.html. For assistance and/or guidance in the grade appeal process, students may contact the Associate Dean’s Office.

ATTENDANCE
Attendance is mandatory for your success, will be recorded during each class session.

- You will lose a single letter grade on your fourth (4) absence.
- Five (5) absences will result in the drop of another letter grade.
- Six (6) absences will result in the failure of the course.
- Three (3) late arrivals or early departures will result in the recording of one (1) full absence.
- Students are required to attend class for the duration of the scheduled time or until the Professor dismisses the class.
- Attending critiques are mandatory.

Description:
The student will learn to use microcontroller-based electronics to control electronic and kinetic sculpture and learn about conceptual aspects of timing, interaction and motion through simple projects. These controllers with the related help files and books, allow non-technically trained users to make use of and join many types of electronics including sensors such as proximity, distance, light and temperature sensors, input devices such as buttons, switches and keyboards, and output devices such as LEDs, motors, servo motors, and solenoids. The output of these microcontrollers can be easily extended with relays, infrared controllers like those used on televisions, and some other wireless means. Internally the computers allow for complex timing and decision-making based on inputs, and some ability to do text processing. By learning one platform you gain the ability to use many different types of electronics. It becomes like an "electronic toolkit for the visual arts."

Hobby microcontroller platforms like the Arduino®, the controller which we will be using, have many advantages. One is that these platforms have help files aimed at the non-technical user; “How To” guides. Another is that add on equipment is also designed for non-technical users and tends to be inexpensive. A third advantage is that there are plenty of help forums available.

A high level of commitment and initiative is expected in this class. Help will be available. Students are strongly encouraged to discuss the class with the instructor before enrolling. Students must have taken Design I and II before enrolling. Ideation skills, some ability to assemble objects and intrinsic motivation are expected.

Student Learning Outcomes
1. Students will learn to make aesthetic decisions involving timing of movement or light and a sculpture’s reaction to stimuli.
2. Students will learn to write simple programs for a simple microcontroller to control kinetic sculpture.
3. Students will learn to interface the microcontroller with a variety of output devices such as light emitting diodes, dc motors and stepper motors, solenoids and relays.
4. Students will learn to use the microcontroller with various input devices including proximity sensors, distance detectors, switches, and light sensors.
5. Students will learn to safely construct simple electronic circuits for low voltage DC, will begin to learn about safely interfacing with 110-volt AC devices.
6. Students will begin to learn to solder small circuitry.
7. Students will experience learning about the Arduino platform from books, and online support forums.
8. Students will learn to use online help and tutorials to extend what they can do with these devices.
9. Although the aesthetic content is very formal and arguably not very broad, "minimal", the student will begin to learn to express themselves in narrow confines.
Required Materials

- Adafruit Arduino Starter Kit http://adafruit.com/products/68 $65
  The individual components can be ordered through other companies, but this would be overly complex. Other electronics will be provided by the instructor. It is possible that boards or parts will become burnt out through a mistake. So far this has been a rare occurrence.

- Low Watt Electric Soldering iron 15-30 Watt. Do not buy a big soldering "gun". The box lumber/hardware stores have these, Altex does, and Radio Shack. Students liked the 25 watt Weller brand iron available at Home Depot for $19.95 Other stores have it too.


- Safety glasses.
- Something to take and keep notes with. You will need these notes daily.
- The big question is, “do you need a laptop?” the answer to this is no. But it would be VERY helpful. You will need access to a computer to install the Arduino Program on. It can be Windows, Mac or Linux. Access to a computer may become necessary for some assignments. Having a laptop, even if old will speed things up. It can be old enough that it cannot get online and it will still be helpful if you have a USB stick. If this is an impediment to your taking the class, please see me. I may be able to help. It must be able to run an Arduino Interface: https://www.arduino.cc/en/Main/Software

- Construction materials such as pink foam board may need to be provided by the student. Some small hardware is available from the instructor.

Requisites
Pre: Students must be comfortable with computers, but they do not need to know any specific software package. All of the major software used for this class is open source and relatively simple. Students must know how to assemble simple objects made of wood and foam without help. Students must get the woodshop orientation in order to use it. You may not need it.

Students will be required to use the campus email account, have a Dropbox® account and sign up for and perhaps use a YouTube® account.

Examples of kinetic, light, and other electronically controlled art will be shown during class. Students must participate in discussions.
Academic Honesty.

Unless the instructions call it a test or quiz, code and wiring diagrams can be copied among students, online sources, anywhere. If you are using code from another source that is substantial (say more than 3 lines) list the source in comments in your code. If there is a URL include it. Failing to do this is academic dishonesty, it can also be theft, and it also makes it hard if you need further information from the code’s author. If students work together to write programs this is acceptable, but your fellow students should be credited in the comments.

That said, you must be able to understand the code well enough to alter it for your own use so that it can be worked on in class. If the teacher believes that you do not understand it, you will be asked to explain it. If you cannot, the code will be considered not turned in until you can explain it. If any code is used that is not contributed by the student and that is not open source, or is not in the public domain, and is used under academic fair use, it must be clearly marked as such using comments.

The semester will be broken into assignments. Due dates and quiz dates are subject to change.
1. Setup, Startup, Blink!

**Student Learning Outcomes**
Student will learn basic safety requirements for the class. Other safety issues will be discussed as the class progresses. Student will learn to set up the Arduino platform and send sketches (programs) to the board.

**Lectures and Demonstrations**
Safety
Setup
Basic anatomy of a sketch (program)

**Tutorials and help sheets**

https://learn.sparkfun.com/tutorials/what-is-an-arduino Read this introduction too.

https://learn.adafruit.com/lesson-0-getting-started/the-lessons
LadyAda Lesson 0 and Lesson 1

**Description of Assignment: Blink! A**
Set up the interface with the computer, read the tutorials above and get your microcontroller to blink its on-board at a rate of 5 times a minute for 100 milliseconds with a 100 millisecond rest between each blink. (Ignore the processing time.)
My hope is that this will be done by the second class day, but problems, questions etc. will be handled day 2
Then get your arduino to blink once short (100 millisecond) with a 100 millisecond break, and then once long (200 milliseconds) with a 200 millisecond break.

Take home project. Demonstrate that you can make the Arduino Blink to your instructor’s specifications. A discussion of minimalism or perhaps formalism and the blink. Bring your Arduino into class blinking to these specifications.

**Quiz 1:** Simple in class quiz on paper to demonstrate gained knowledge.

**Subjects for quiz 1:**
delay (),
;
int
digitalWrite()
pinMode()
//
/*/ */
Email your Arduino code for this Blink Assignment to Louis.Katz@tamucc.edu
Make sure your Arduino file is labeled Blink1FirstNameLastName
The code must have a header such as:
//Blink A (project title)
//Louis Katz ( use your own name )
//2016-02-30
//louis.katz@tamucc.edu (use your own email)
//This code is based on the Blink Program contained in the Arduino IDE
(identify sources)
2. **Blink B external LED's**

**Student Learning Outcomes**
Student will learn basic sketch (program) components. Header, Setup, Loop, Student will begin to learn about Ohms law.
Student will learn to use LED's and simple ways to find values for the ballast resistor for an LED. [http://led.linear1.org/1led.wiz](http://led.linear1.org/1led.wiz)
Student will learn to wire a switch and begin to learn about types of switches.
Student will practice soldering for electronics.
Student will learn to consider timing as an aesthetic parameter.
Student will learn to use serial communication between a computer and their Arduino.
( this may end up waiting until later in the course) Student will learn to operate the CNC Router table specifically to make a translucent box for the project. Tutorials for the XCarve CNC Router are at: [http://falcon.tamucc.edu/wiki/Katz/CreativeEngineeringLab](http://falcon.tamucc.edu/wiki/Katz/CreativeEngineeringLab)  
Steps: design, prepare the SVG file, Import to Easel, Print, Assemble,  
[Student will learn to use the 3D extrusion printer.] If we do this it will be a simple print of an Arduino holder design.

**Lectures and Demonstrations**
Lecture: Water Analogy for electricity. Parallel and series circuits.  
[http://falcon.tamucc.edu/wiki/Katz/ElectricityY](http://falcon.tamucc.edu/wiki/Katz/ElectricityY)  
Linked Tutorials by Derek Owens  
Current, Voltage, Resistance Ohms law.  
Lecture: Closer look at a sketch  
Demonstration: Soldering  
Demonstration: Using a breadboard  
Demonstration: Determining the value of a ballast resistor for an LED using an online calculator.  
Lecture/demo/web search/Cookbook : Basic sound with an Arduino and a speaker.  
Lecture/demo/websearch/cookbook/breadboarding

**Tutorials and help sheets**
LadyAda Tutorial lesson 2 and 3  
[http://www.ladyada.net/learn/arduino/lesson2.html](http://www.ladyada.net/learn/arduino/lesson2.html)  
[http://www.ladyada.net/learn/arduino/lesson3.html](http://www.ladyada.net/learn/arduino/lesson3.html)  
[http://www.ladyada.net/learn/arduino/lesson4.html](http://www.ladyada.net/learn/arduino/lesson4.html)  
Libraries, Serial Communication
LEDs
https://learn.adafruit.com/all-about-leds/what-are-leds-used-for We will continue to work through this tutorial as the semester progresses

**Exercises**
soldering a few practice joints.
Assembling the Breadboard Shield (Do not glue the white breadboard to the circuit board.)
Using a bread board
Learning about switches with test leads
Serial communication
Using the breadboard make three external LED's blink. Using analogWrite make at least one of them change brightness.

**Description of Assignment: Blink B**
With your Arduino as the controller build a lightweight light that flashes, pulses or something. It is important that the timing be not just considered but be seen as a crucial part of your design. Your device LEDs will need to operate on 4 AA batteries with a separate battery for the Arduino. AA Battery cases will be provided. So whatever it is, it will need to hold the AA battery case, the 9V Arduino battery case, and the Arduino. It is suggested that you build into some very lightweight plastic device or container. Or it could be built with pink foam using the Router Table.

It could be a shampoo bottle with an interesting form or a large enough very lightweight child’s toy. It could be Tupperware®. It would probably be smart to get several identical objects. It can be translucent, or you could pierce it. Make it big enough to accommodate the Arduino, the Protoshield, Battery Packs, and LEDs and the speaker.
The light circuit must have a switch. The Arduino too must have a switch (the one on the battery case will work if it is accessible. We are likely to need the switch again.
Consider the personality of your light. Can you make it edgy, coy, nervous, assertive, scared? How should its appearance affect its timing? What color should the LED’s be?
This object should be a finished piece, even if simple, ready for display. I intend to display them in the hallway even if only for an afternoon.
**Due Class #8 (subject to change)**

**Subjects for Quiz 2:** (this might be given in the middle of the next assignment the date will be determined)

\[ V=I*R \]

amps, volts, ohms. If you know 2 of these you have to be able to find the third. You should know the analogy with water reasonably well.
Parallel vs Series resistors and the associated effects on amps and voltage
Serial.print(), Serial.println()
Serial.read()

Email your Arduino code for this Blink Assignment to Louis.Katz@tamucc.edu
Make sure your Arduino file is labeled BlinkBFirstNameLastName
The code must have a header such as:
//BlinkB
//Louis Katz
//2016-02-30
//louis.katz@tamucc.edu
//This code is based on the Blink Program contained in the Arduino IDE
3. **Blink C**

**Student Learning Outcomes:**
Student will learn to calculate Watts  
Student will learn to use the TIP120 or a MOSFET like an electric switch, alternatives will be discussed (2n2222 and MOSFETs)  
Ugly, and blank drilled circuit board construction.  
Student will learn to use "for" loops.  
Student will learn the function of Pulldown and Pullup resistors and learn to use INPUT_PULLUP  
Student will understand scope of variables

**Lectures:**
TIP 120, 2N222 and MOSFET comparison.  
Layout of Protoshield  
Functions may be covered during this project instead of the next one.  
for loops and scope

**Pertinent Materials:**
Arduino Cookbook chapter 7.3  
or https://learn.adafruit.com/rgb-led-strips/usage?view=all (more complicated)  
Pull-up Pull-down resistor links:  
https://learn.sparkfun.com/tutorials/pull-up-resistors/what-is-a-pull-up-resistor  

Student will rework the previous project with more LEDs powering them with two battery packs and using MOSFETS or TIP120's to control them.
4. Interaction

**Student Learning Outcomes**
Student will learn to use a conditional statements (if) and the equals symbol `==`
Student will learn to use functions and use them in their program
Student will learn how to read a push button switch with your Arduino.
(Cookbook 5.1)
Student will learn how to use a proximity sensor.
Student will learn how to use a distance sensor.
Student will learn to wire an 8 ohm speaker (handout).
Learn how to make the speaker make a sound and how to vary it.
scope of variables

**Tutorials and help sheets**
LadyAda Lesson 5 Switches, conditional statements (if).
Functions. [http://falcon.tamucc.edu/wiki/Katz/FuncTions](http://falcon.tamucc.edu/wiki/Katz/FuncTions)
Speaker Handout.

**Lectures and Demonstrations**
Comparison of conditional statements
Functions, Scope review.
Proximity and distance sensors Problems and a partial solution
Speakers Ohms, Watts, Power, electromagnetism.

**Task**
Install the class libraries from Dropbox unless I email them.

**Excercise**
1. Learn how to read a push button on your Arduino, or switch.
   Demonstrate this in class to the instructor.
2. Learn how to use a proximity sensor. Demonstrate this in class to the instructor.
3. Learn how to use a distance sensor. Demonstrate this in class to the instructor.
4. Learn to wire an 8 ohm speaker (handout)
   Learn how to make the speaker make a sound and how to vary it.
   Demonstrate it in class to your instructor

**Interaction A**
Make your light from assignment 3 react to a person’s presence with a proximity sensor or distance sensor. Make the timing decisions have
meaning or appear to. Intendedness can be hard to communicate with timing. You must use a proximity or distance sensor. Somewhere in your sequence use sound from the speaker. There will be many devices in the same space. You may not have more than 200 milliseconds of sound every 10 seconds.

This object should be a finished piece, even if simple, ready for display. I intend to display them in the hallway.

Due Class 11 Quiz 3
for and if statements understanding functions scope
Watts, kilowatt hours

Assignment Three : Interaction B . This assignment is tentative. Using a provided sound recording circuit board make the same sort of project as Interaction A . The kind of recording will be discussed in class. Start work on this soon after starting Interaction A so that technical problems have time to be worked out.
5. **PWM (pulse width modulation and H Bridge).**

**Student Learning Outcomes**
Student will learn how to pick a fuse for a simple circuit.
Student will learn to calculate Watts from amps and volts.
Student will learn to control simple DC motors including their speed and direction.
Student will learn to control Stepper Motors, and Hobby Servos.
Student will learn about Pulse Width Modulation (PWM)
Student will integrate motors into a project.
Student will learn to consider types of movement as an aesthetic parameter.

**Tutorials**
https://learn.adafruit.com/all-about-leds/what-are-leds-used-for KVL (Kirchhoff's Voltage Law)
Relay control
https://falcon.tamucc.edu/~wiki/uploads/Katz/arduinoandrelay2.gif

Transistor control of a motor
https://falcon.tamucc.edu/~wiki/uploads/Katz/arduinoandmotor.gif

Stepper Motors using tb6612 board from Adafruit

Servo Motors

**Lectures, Demonstrations**

HBridge wiring diagram.
Ohms Law refresh, determining current, sizing fuses. Kirchhoff's law applied to simple LED circuits.
PWM - pulse width modulation for servos and and H Bridges. Apparent voltage for motors.
Speed control
Introduction to capacitance and inductance.

**HBridge**
See if you can figure out how to set up the HBridge and get it working with the helpsheets online. The HBridge and two motors will be provided.
Warnings and help will be given to prevent the board from burning out.

**Exercises**
1. Learn to control speed and direction of your DC motors. Demonstrate this in class.
2. Learn to use a hobby servo. Demonstrate this in class.
3. Learn to use a stepper motor. Demonstrate this in class. Stepper motors will be available.

There is no project for HBridge, just the demonstrations. Turn in your code for all three exercises.
5. **Motor Build out All Together.**

**Student Learning Outcomes**
Student will learn to put it all together.
Student will learn to produce relatively clean code with functions where they are helpful.

**Lectures, demonstrations,**
LCD Board (possible)
Real Time Clock (possible)
Thermocouple Sensor (possible)
Storage in EPROM (possible)

**Assignment: Motor Build out All Together**
Make a piece of art. It must have a motor, a servo motor, LEDs, a proximity sensor and a speaker. It can be flattish or volumish. Just like your light, how an object moves gives it personality, you can control in pulses, acceleration, deceleration.
Use functions to control the motor, servo motor, LEDs, proximity sensor and speaker
Due class 27

Class 28 Trial with all devices in one space.
Class 29 Display in Hallway.
Final Exam Period, Clean up, evaluation, discussion, information distribution, archive, document.

**Grading**
Absences will have an effect of grades (see top). Students are expected to be in class. **Students missing class must have someone take notes for them or material will be missed.** It may be hard to learn this material by oneself. Find a partner or someone to take notes in case of absence. Lecture material will not be repeated for students missing class.
The final exam period counts the same as two classes for attendance purposes. All work still has the same deadline. Students expecting to miss class for religious holidays, academic conferences, or required sports events are required to notify the teacher at the beginning of the semester (before the fourth class meeting) if they expect to be excused. Excuses beyond this are at the instructor's sole discretion.

The assignments all require that a copy of the code used to control the Arduino be
emailed to the professor by the class in which it is due to be ontime. But ALL code and projects must be done by the final exam period.

All code must have a comment header with the Assignment Name, Number and Student Name.

Criteria used for grading of individual assignments:

Code (The Sketch):
Excellent code is neatly indented to be easily readable. Excellent code has comments labeling variables and sections of the code so that it is easy to understand. It also has a section explaining what it does and if complicated how it does it. It lists what pins are used or explains this with comments next to pin variables.

Excellent Code functions as intended. Excellent Code with no flaws is worth 100 percent of the code grade. You must be able to demonstrate that you understand the code in order for it to be excellent. Code that works but is not excellent is worth 75 percent of the code grade. Please note that if it works, the difference here is just formatting and comments.

Code that it late less than a week will have 5 percent deducted from it. Code that is late more than a week will have 15 percent deducted from it. Code that does not work but shows that most of the material was learned is worth 70%. Please note that if this is fixed it can be worth 95% if turned in under a week late and it is well labeled and meets all the other requirements for Excellent Code.

Code that falls between these extremes may be given an intermediate amount.

Expect to always be asked to explain late code, but be prepared to explain any code you turn in.

Code not that is not turned in within two weeks of the due date will earn a 0. Given that you can learn from other students why would you do this? All code must be turned in (emailed) prior to the final exam period.

The Objects
An Excellent project works the way it is intended and demonstrates the concepts and equipment listed in the project description. An Excellent project looks like it was intended to be built the way it is. Details are intended or at least look mostly intended. An Excellent project has a cohesive personality. 90-100% of the object portion of the assignment. The code is separate from this. An excellent object is neat, has color coded leads where possible (red or black + white or green - or common, blue yellow orange or other for signals. Soldering
should be clean. In soldered object long leads must be insulated. Breadboarded assignments only require color coding.

An Excellent object that requires soldering does not have cold joints and any messiness is not capable of shorting out.

An object that functions properly and demonstrates the concepts and equipment listed in the project description is worth 80% of the grade. If motors go, and the lights flash and it does not show a cohesive personality, intendedness, this is still worth the 80%.

Objects that do not function properly but do function or are close to functioning are worth 70-80 percent of the grade.

Objects late less than 1 week will have 5 percent deducted from the grade. Assignments late more than a week but less than two will have 15 percent deducted from the grade.

Grading

BlinkA take home test. 10 points
Quiz 1 5 points

BlinkB External LEDs
Code 30
Object 10
Quiz 2 10 points

Blink C
Code 30
Object 20

Interaction A
Code 40
Object 20

Quiz 3 10

HBridge
Code for exercises 10 each
Object (no assignment)

Motor Build Out
Code 60
Object 40
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<tr>
<td>A</td>
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<td>B</td>
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